A NETWORK APPROACH TO PLANT CONSERVATION IN NEW ZEALAND[1]

John Sawyer[2]

New Zealand has long been regarded as one of the world's biodiversity hotspots (Myers et al., 2000); therefore, the country's flora represents a global priority for plant conservation action. Factors influencing this significance are the high degree of endemism, the evolution of its species in a largely mammal-free environment dominated by birds, and the threatened status of its species and ecosystems. New Zealand has 60 endemic vascular plant genera, comprising 13% of New Zealand genera, and 1984 vascular plant taxa are endemic at the species and infraspecific level, representing 82.2% of these taxa (de Lange & Rolfe, 2010). In addition, 38% of New Zealand's indigenous vascular plants have been recognized as Threatened or At Risk (de Lange et al., 2009).

For the last two decades, plant conservation in New Zealand has been led by the New Zealand Department of Conservation (DOC; the central government agency charged with the protection of indigenous species) and local government (charged with environmental management under the Resource Management Act 1991), with participation from botanic gardens, nongovernmental organizations such as the Royal Forest and Bird Protection Society, the World-Wide Fund for Nature, as well as regional botanical societies. Numerous scientific institutions have researched New Zealand's flora, including most New Zealand universities and Crown Research Institutes (such as Landcare Research, National Institute of Water and Atmospheric Research, and AgResearch). From Sir Joseph Hooker's *Handbook of the New Zealand Flora* (1867) to Thomas Cheeseman's *Manual of the New Zealand Flora* (1906), there has been a long history of botanical research in New Zealand that culminated in the *Flora of New Zealand* nine-volume series (Allan, 1961; Moore & Edgar, 1970; Healy & Edgar, 1980; Galloway, 1985; Webb et al., 1988; Edgar & Connor, 2000; Galloway, 2007 [Vols. 1 and 2]; Engel & Glenny, 2008). All these organizations and agencies have demonstrated a strong desire to describe, understand, and protect New Zealand's unique plant life as part of a wider conservation movement that has existed in New Zealand for more than 100 years.

At the time New Zealand adopted the Global Strategy for Plant Conservation (GSPC) in 2002, there was limited coordination of national efforts, and no single agency appeared to be successfully championing the cause of New Zealand plant life. New Zealand needed a greater degree of coordination, advocacy, and action amongst the many governmental, nongovernmental, community, and research organizations involved in plant conservation in New Zealand.

Biodiversity Declines in New Zealand

The ongoing global decline in biodiversity has been documented widely and is caused by environmental changes such as climate change, habitat destruction, unsustainable harvesting, and the impact of invasive pests and naturalized plants (Butchart et al., 2010). In New Zealand, vascular plant populations and ecosystem structure and functioning are threatened by a broad suite of animal pests, including possums, rats, mice, mustelids (stoats, ferrets, weasels), goats, rabbits, pigs, deer, and stock. Bird and egg predation has impacted plant populations through loss of plant pollinators and seed dispersers (Anderson et al., 2011). Naturalized plants compete with native species; adventive species now outnumber native species in the wild (Howell & Sawyer, 2006). Humans continue to destroy intact indigenous plant communities and to intensify agricultural production in landscapes once dominated by indigenous plants. A lack of understanding of ecological declines has exacerbated the situation, with approximately 60% of New Zealanders believing the natural environment to be in good or very good condition (Hughey et al., 2008).

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[2] Auckland Council, Private Bag 92300, Auckland 1142, New Zealand. john.sawyer@aucklandcouncil.govt.nz.

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This suite of environmental threats has conspired to increase the number of critically threatened vascular plant species by 60% over the last five years (de Lange et al., 2009). The most recent assessment of the conservation status of the flora occurred in 2009; 180 vascular plant taxa were listed as Threatened, which included 91 as Nationally Critical, 45 as Nationally Endangered, and 44 as Nationally Vulnerable, with an additional six taxa considered Extinct (de Lange et al., 2009). A further 651 plant taxa were listed as At Risk and comprise 83 Declining, six Recovering, 20 Relict, and 542 Naturally Uncommon taxa. In total, 38% of New Zealand's total indigenous vascular flora has been recognized as Threatened or At Risk (de Lange et al., 2009). Those declines precipitated a need for improved coordination to halt the decline in New Zealand's indigenous plants.

A Networked Approach, the New Zealand Plant Conservation Network

The New Zealand Plant Conservation Network (<http://www.nzpcn.org.nz/>) was formed in 2003 as a response to the GSPC (Convention on Biological Diversity [CBD], 2002) and the New Zealand Biodiversity Strategy as developed through the DOC and the Ministry for the Environment (MfE) in 2000. The New Zealand Plant Conservation Network came into being against a backdrop of a nationwide decline in native plants and was founded with support and advice from the Australian Network for Plant Conservation (<http://www.anbg.gov.au/anpc/>), which was established in 1991. The New Zealand Plant Conservation Network's vision is that: "No indigenous species of plant will become extinct nor be placed at risk of extinction as a result of human action or indifference, and that the rich, diverse and unique plant life of New Zealand will be recognised, cherished and restored." The New Zealand Plant Conservation Network is now composed of a collective of people and agencies reflecting all walks of New Zealand life (see Table 1). It is engaged in a wide variety of projects mostly stemming from the 16 targets of the GSPC including training, seed banking, research, and provision of information.

Table 1. Members of the New Zealand Plant Conservation Network, <http://www.nzpcn.org.nz>.

Botanic gardens
Plant nurseries
Researchers from New Zealand universities and Crown Research Institutes
Ecologists and land managers from central and local governments
Landowners
Gardeners
Botanists
Teachers
Business people

An Online Flora for New Zealand

The Network's first initiative in 2003 was the establishment of a web site to provide information about New Zealand's threatened vascular flora (<http://www.nzpcn.org.nz/page.asp?flora_vascular>). The overall Network web site (<http://www.nzpcn.org.nz>) has since grown to become a central repository for information about New Zealand's flora including all native and naturalized vascular plants, liverworts, mosses, and some fungi. It is now the central hub for the New Zealand Plant Conservation Network in all its communications and is used by Network members to communicate with each other using the online forum, to learn about plants and ecosystems, to buy publications, to test their knowledge of the flora using an online quiz, to read the news or newsletters, and to download species factsheets and plant photographs. The web site now receives more than 450,000 visits annually (cf. Table 2). Site visitors can download species information as PDF files automatically created by harvesting information from online databases or can make personalized plant books of up to 20 species. The web site provides links to other botanical resources such as New Zealand herbaria, the New Zealand digitized flora (<http://floraseries.landcareresearch.co.nz/pages/Index.aspx>), and plant nursery web sites.

Online Phenology Recording in New Zealand

A phenology recording system was built in 2010 and installed on the New Zealand Plant Conservation Network web site to allow recording of observations of plant flowering, fruiting, and dieback. This feature was intended to complement other international initiatives such as Project Budburst in the United States. (<http://neoninc.org/budburst>) and Nature Detectives in the United Kingdom (<http://www.naturedetectives.org.uk>). Both provide citizen scientists with a tool to document local changes in phenological events over time and to compare regional results with those from other parts of their respective country and with historically documented flowering and fruiting times. This also provides plant nurseries and community groups and landowners involved in ecological restoration with valuable real-time information about regional seed collection times.

Table 2. Features and usages of the New Zealand Plant Conservation Network online, <http://www.nzpcn.org.nz>. The web site receives more than 450,000 visits annually.

Features	Daily Usage
More than 23,000 plant photographs	1200 site visits per day
6500 species pages	800 documents downloaded daily (average over six months)
Links to other botanical resources	20,000 images viewed daily (average over six months)
Online quiz	
Make your own book system	
Species factsheet PDF maker	

Since June 2010, more than 8000 phenology records have been made to the New Zealand Plant Conservation Network's phenology recording system.

Plant Advocacy and Public Outreach in New Zealand

Raising public awareness of native plants is a high priority for the New Zealand Plant Conservation Network to prevent further declines in indigenous plant populations and ecosystems. The focus for this advocacy has been to raise awareness of the threats that plants face in the wild and of the actions people can take to sustainably use and conserve vascular plant taxa. This has been achieved through a variety of means (cf. Table 3). An annual award scheme was started in 2005 and is used to identify people and organizations that have made the greatest contribution to plant conservation in New Zealand. Awards have been made to schools, plant nurseries, individuals, local government, and communities. An annual vote to find New Zealand's favorite plant was begun in 2002 by Professor Ian Spellerberg (Lincoln University, New Zealand). The purpose was to discover why New Zealanders love their native plants and to promote the flora. Since 2005, this vote has been conducted via an online voting system on the New Zealand Plant Conservation Network web site. Winners have included: *Lepidium oleraceum* G. Forst. (2005, Cook's scurvy grass, Brassicaceae); *Brachyglottis huntii* (F. Muell.) B. Nord. (2006, Chatham Island Christmas tree, Asteraceae); *Epilobium microphyllum* A. Rich. (2007, willowherb, Onagraceae); *Ficinia spiralis* (A. Rich.) Muasya & de Lange (2009, pingao, Cyperaceae); and *Myosotidium hortensia* (Decne.) Baill. (2010, Chatham Island forget-me-not, Boraginaceae). The New Zealand Plant Conservation Network has published numerous books, reports, and materials that promote plants and include a monthly newsletter (*Trilepidea*), a threatened plant poster, national plant checklists for native and naturalized species (cf. Howell & Sawyer, 2006; de Lange & Rolfe, 2010), and a detailed assessment of the threatened plants of New Zealand (de Lange et al., 2010). These publications are sold via an online shop on the Network's web site (<http://www.nzpcn.org.nz/shop_products.asp>).

Table 3. Advocacy by the New Zealand Conservation Network.

Annual awards scheme
Vote for your favorite plant competition
Publications, including newsletters, promotional materials, plant checklists and books
Submissions on government policy

Plant Conservation through Marae-based Training

To increase plant conservation capacity and capability, the New Zealand Plant Conservation Network has developed a plant training course consisting of four modules. Each module is designed for delivery over a two-day period on a marae (a traditional Maori tribal meeting place). Those modules are: (1) an introduction to plant life in New Zealand (Reid et al., 2009); (2) managing conservation covenants (Reid & Sawyer, 2010); (3) native plant nursery management and plant cultivation (Reid et al., 2011); and (4) streamside and wetland management (Singers & Reid, in prep.) These modules are intended to provide a marae-based learning experience, to increase plant identification, pest control, and plant propagation skills, and to expose an increasing number of people to plant conservation principles and techniques.

Ex situ Conservation in New Zealand

The New Zealand Plant Conservation Network developed the New Zealand Threatened Plant Seed Bank (<http://www.nzpcn.org.nz/page.asp?conservation_seedbank>) as a contribution to the global initiative run by Kew's Millennium Seed Bank affiliated with the Royal Botanic Gardens, Kew, in the United Kingdom (<http://www.kew.org/science-conservation/save-seed-prosper/millennium-seed-bank/index.htm>). Seed bank-

ing was identified as a high priority by the Network due to the earthquake-prone nature of the New Zealand landscape. Ex situ insurance populations would be especially significant should wild plant populations be destroyed. Ex situ seed banking was also seen as a relatively cheap way to protect indigenous plants. This work was sponsored by MWH-New Zealand Ltd. (a private engineering and environment company). The seed bank itself was established at the Margot Forde Germplasm Centre in Palmerston North and is managed by AgResearch (<http://www.agresearch.co.nz>), which was originally set up to store agricultural seed.

David Given Threatened Plant Research Trust

In 2007, the Network established the David Given Threatened Plant Research Trust in memory of David Given, who contributed significantly to plant conservation in New Zealand and globally. Given's work in New Zealand was an important building block of the current threatened plant program, including threatened plant listing and advocacy (see Given, 1976, 1981). The trust was established to provide regular scholarships to researchers studying threatened plants and plant communities in New Zealand.

Challenges in New Zealand toward the GSPC 2020 Goals

The New Zealand Plant Conservation Network is a hugely successful product of the GSPC (CBD, 2002). By providing a local, in-country response to the global plant conservation crisis, the New Zealand Network has shown what can be achieved by harnessing the power of individuals and organizations to achieve a common purpose. Despite the notable successes of this national plant network, a number of challenges remain for plant conservation in New Zealand. These can be categorized into four themes, as follow.

(1) In-situ protection of critically threatened species populations. Nature conservation resourcing is not always aligned strongly with the needs of New Zealand's most threatened plant species and ecosystems. Limited funding exists to resource threatened plant species or ecosystems. Many funds support common, more charismatic plant species and ecosystems as a preference. There is no legislation protecting threatened plant species in the wild, irrespective of land tenure. Securing greater funding for threatened species and ecosystems is a New Zealand Plant Conservation Network priority to target active management of important plant areas.

(2) Education and advocacy. Increased public awareness is needed of the role that plants can play in fixing environmental problems. Many challenges facing land managers can be ameliorated through the use of plants. Plants may be used to improve flood prevention, soil conservation, carbon sequestration, coastal and riparian infrastructure protection, and provision of shade and shelter to humans. Advocacy about these roles of plants and the way humans can make use of them will increase the value they attribute to them in the landscape.

(3) Use and appreciation of plants. A key ingredient in the decline in native plants in New Zealand is their invisibility. A critical job is to position native plants at the heart of landscapes, cities, and, therefore, human consciousness. The integration of plant conservation into the management of economically productive land is also a challenge facing New Zealand. A historic dichotomous view of land use has evolved, whereby native species are confined to parks and reserves, and economic production occurs in the areas between which are largely free of native species.

(4) Capacity building. A priority for the New Zealand Plant Conservation Network is to build the Network's training modules into a national Diploma in Plant Conservation to increase the number of people with plant conservation skills. Another challenge is to increase the size of the David Given Threatened Plant Research Trust fund to provide more frequent and larger scholarships. The future expansion of the New Zealand Plant Conservation Network's program to become a partner in a Pacific-wide organization may also be considered. Such an organization could provide opportunities for technology and skill transfer throughout Oceania or the Pacific Oceanic Islands. This may include monitoring, seed banking, propagation, information management, pest control, and habitat protection in places where indigenous plants face similar threats as seen in New Zealand.

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